

Pairing symmetry of the one-band Hubbard model in the paramagnetic weak-coupling limit: A numerical RPA study

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Abstract

© 2015 American Physical Society. We study the spin-fluctuation-mediated superconducting pairing gap in a weak-coupling approach to the Hubbard model for a two-dimensional square lattice in the paramagnetic state. Performing a comprehensive theoretical study of the phase diagram as a function of filling, we find that the superconducting gap exhibits transitions from p-wave at very low electron fillings to dx^2-y^2 -wave symmetry close to half filling in agreement with previous reports. At intermediate filling levels, different gap symmetries appear as a consequence of the changes in the Fermi surface topology and the associated structure of the spin susceptibility. In particular, the vicinity of a Van Hove singularity in the electronic structure close to the Fermi level has important consequences for the gap structure in favoring the otherwise subdominant triplet solution over the singlet d-wave solution. By solving the full gap equation, we find that the energetically favorable triplet solutions are chiral and break time-reversal symmetry. Finally, we also calculate the detailed angular gap structure of the quasiparticle spectrum, and show how spin-fluctuation-mediated pairing leads to significant deviations from the first harmonics both in the singlet dx^2-y^2 gap as well as the chiral triplet gap solution.

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